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Corn (Zea mays L) Development Based on Drone-Based Vegetation Index Trough NPK Fertilization

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Abstract

Maize is one of the most important food crops after rice. This study aimed to obtain one or more doses of fertilizers that provide high growth and productivity, obtain one or more varieties of maize that have increased productivity, and obtain interactions between doses of fertilizers with maize varieties that deliver high growth and productivity. The research was conducted at the Experimental Farm (KP) of the Bajeng Cereal Crops Research Center, Bajeng District, Gowa Regency, South Sulawesi. At an altitude of 27.2 meters above sea level, with coordinates 5018'21.5 "N, 119028'38.6 "E and an average temperature of 28.50C. The research was conducted from September to December 2022. This study used a separate plot design, fertilizer dose as the main plot consisting of 3 fertilizer doses, namely N:P:K equals 160:120:80 kg N.ha-1, N:P:K equals 200:150:100 kg N.ha-1, and N:P:K equals 240:180:120 kg N.ha-1. The subplots were corn varieties: Sinhas 1, Jakarin, Nasa 29, JH 36, Bisi 18, ADV Joss and Pioner. The fertilizer dose with the highest productivity compared to the other five is N:P:K equals 240:180:120, with an average productivity of 6.66 t.ha-1. The variety that produces the highest productivity compared to the two types is ADV Joss, with an average productivity of 9.28 t.ha-1. The combination of N:P:K fertilization dose equals 160:120:80 with ADV Joss variety gave the highest productivity compared to the combination of fertilization dose and other types with an average productivity of 9.38 t.ha-1. The correlation between productivity and parameters such as plant height, number of leaves, cob weight, cob diameter, cob length, cob length, number of seed rows per cob, seed yield, 1000 seed weight, and NDVI showed a positive interaction.

Keywords: fertilization, maize, NDVI, productivity

A. Introduction

Maize is one of the most important food crops after rice. Maize has a strategic role and economic value and has the opportunity to be developed. Maize is the primary source of carbohydrates and protein after rice. Maize is also a raw material for the food and feed industry and is one of the export commodities. The extensive use of maize in various sectors has increased the demand for maize.

For the last seven years, Indonesia's maize production data has been below the target since 2016; in 2016, maize production was 23.18 million tons, lower than the target of 24 million tons. The same thing happened in 2017 and 2018, below the target of 25.2 million tons and 26.5 million. In 2019, maize production was 27.61 million tons, while the target was 27.8 million tons, and in 2020, maize production was 28.63 million tons, still low from 29.05 million tons (Directorate General of Food Crops, 2020). According to Ministry of Agriculture data, maize imports in mid-2019 reached 0.58 million tons. The mid-2019 achievement was close to the previous year's sense of 0.74 million tons. In line with the increasing national maize crop production, efforts need to be made to significantly increase maize productivity so that it can meet the needs, increase exports, and reduce imports. Increased maize yields can be developed by selecting varieties and fertilizer doses.

One way to increase maize yields is to use quality seeds of superior varieties to produce high results. However, more than the use of select types of sources needed to support increased production, fertilizer is also required to meet the needs of plants. Early-maturing high-yielding varieties responsive to N, P and K macronutrient fertilization have significantly increased crop production (Agency for Agricultural Research and Development, 2021).

The synthetic fertilizer commonly used by farmers is NPK, which contains N, P, and K, essential plant nutrients. Increasing the dose of N fertilization in the soil directly increases the protein (N) content and production of corn plants. Still, fulfilling N elements alone without P and K elements will cause plants to lodge easily, be sensitive to pest attacks and decrease production quality (Pusparini, Yunus and Harjoko, 2018). However, in the field, farmers apply inorganic fertilizers excessively, which hurts the environment.

Maize cultivation combined with innovative farming-based technology utilizing drones is an effort to increase maize production. Smart farming is an intelligent agricultural method based on technology and the provision of data that can be measured and integrated into managing agricultural processes to optimize crop production. In other words, smart farming transforms conventional agriculture into modern agriculture.

One of the methods for evaluating corn crops is using drones or an imaging-based Unmanned Aerial vehicle (UAV). The intelligent farming method includes the use of drones in corn cultivation for monitoring and predicting a yield and the process of fertilizing or spraying pesticides. Drone technology in the monitoring and prediction process will provide analysis information related to crop status through image imaging. This can facilitate farmers in the evaluation process on a broader scale. The objectives of this research are to get one or more doses of fertilizer that provide high growth and productivity, get one or more varieties of corn that have increased productivity, and get an interaction between the dose of fertilizer and corn varieties that provide good growth and high productivity.

B. Methodology

The test was conducted at the Experimental Farm (KP) of the Bajeng Cereal Crops Research Institute, Bajeng District, Gowa Regency, South Sulawesi, at an altitude of 27.2 meters above sea level, with coordinates 5○18'21.5 "N, 119○28'38.6 "E and an average temperature of 28.5○C. This research took place from May to October 2023.

1. Research Design and Procedures

This study was arranged in a Separate Plots Design with a group randomized design as the environment. The main plot (PU) was five doses of NPK fertilization as follows:

P1 = 60 % N:P:K (160:120:80 kg.ha-1)
P2 = 80% N:P:K (200:150:100 kg.ha-1)
P3 = 100% N:P:K (240:180:120 kg.ha-1)

The subplots (AP) were seven maize varieties (v), namely Sinhas I (V1), Jakarin 1 (V2), Nasa 29 (V3), HJ 36 (V4), Bisi 18 (V5), ADV (V6) and NK 212 (V7). Based on this combination, there are 21 treatment combinations repeated thrice, resulting in 63 treatment units. The research used a Legowo 2:1 planting system, corn varieties, urea, SP36 and NPK phonska fertilization. Fertilization was done twice, 15 days after planting and 30 days after planting.

Maintenance included replanting, weeding, thinning, fertilizing, and irrigating. Plant growth was observed until harvest. Harvesting is done on corn cobs when they reach physiological maturity, marked by the appearance of a black layer on the back side of the seed or brownish cobs and drying. After treatment, maintenance and observation of quantitative and qualitative parameters were carried out, and the data were processed statistically and descriptively.

Crop photography is conducted directly in the field using an Inspire 2 Unmanned Aerial Vehicle (UAV) Drone that will be equipped with a 20-megapixel RGB camera with a 4/3 in sensor, 20 mm focal length, and 1/16 second capture speed. Each flight will contain about 1000 or 3000-4000 images for mapping 100 ha of land. Flight planning will occur at 12:00-14:00 in clear weather conditions. Then, the image results are analyzed with ArcGIS software.

Normalized Difference Vegetation Index (NDVI) is an index that describes the greenness of a plant. NDVI is a mathematical combination of the red band and the NIR band used as an indicator of the presence and condition of vegetation and is, therefore, commonly used as an indicator of biomass and relative greenness.

Table 1. Classification of Plant Health Based on NDVI Values.

Plant Healt	Value NDVI
Very Good	0,721 - 0,92
Good	0,421 - 0,72
Normal	0,221 - 0,42
Poor	0,11 - 0,22

(Sumber : http://endeleo.vgt.vito.be/dataproducts.html)

2. Data Analysis

Data analysis to determine the effect of treatment on the measured changes was carried out statistically with the help of STAR 2.1 software. Data analysis was conducted using the ANOVA (Analysis of Variance) method using a separate plot design with a randomized group design as the environment. Parameters that showed a significant effect continued with the BNJ and correlation tests. All morphological, biophysical, and physiological character approaches were analyzed independently to determine the best characters in each selection method. The best selection characters in each course in each selection method were explored together with Image-based Phenotyping characters. This aims to determine the best selection of characters in the approach. The software used in in-depth analysis related to Image-based Phenotyping is ArcGIS.

C. Result and Discussion

1. Result

Table 2. Average productivity (t.ha-1) at different doses of N:P:K fertilizer and varieties

Variety	Treatment			Average	NP (V) BNJ 0.05
	P1	P2	P3		
V1	4.64^{c}_{p}	5.08^{d}_{p}	4.43^{d}_{p}	4.72	
V2	3.81^{c}_{q}	5.67^{cd}_{p}	5.70^{cd}_{p}	5.06	
V3	7.49^{ab}_{p}	7.64^{ab}_{p}	8.11^{ab}_{p}	7.75	
V4	4.39^{c}_{p}	5.26^{d}_{p}	3.93^{d}_{p}	4.53	1.11
V5	6.52^{b}_{q}	6.08^{bcd}_{q}	8.47^{ab}_{p}	7.02	
V6	$\mathbf{9.38^{a}_{p}}$	9.26^{a}_{p}	9.19^{a}_{p}	9.28	
V7	6.66^{b}_{p}	7.32^{bc}_{p}	6.79^{bc}_{p}	6.92	
Average	6.13	6.62	6.66	6.47	
NP (P) BNJ 0.05		1.16			

Notes: Numbers followed by the same letter in column (a,b,c,d) and row (p,q) mean not different in the BNJ test at $\alpha = 0.05$.

Table 2 shows that the interaction between the treatment of N:P:K fertilizer dose 160:140:80 (P1) with ADV variety (V6) gave the highest average productivity value with a value of 9.38 t. ha-1 and significantly different from Sinhas 1 (V1), Jakarin (V2), JH 36 (V4), and Bisi 18 (V5) at the same N:P:K fertilizer dose treatment. ha-1 and significantly different from the varieties Sinhas 1 (V1), Jakarin (V2), JH 36 (V4), Bisi 18 (V5) at the same N:P:K fertilizer dose treatment, the interaction between N:P:K fertilizer dose 200:150:100 (P2) with varieties Sinhas 1 (V1), Jakarin (V2), Pioner (V7), the interaction between N:P:K fertilizer dose treatment 240:180:120 (P3) with Sinhas 1 (V1), and JH 36 (V4) interaction. And not significantly different from the interaction between the treatment dose of fertilizer N:P:K 200:150:100 (P2) with the variety ADV Joss (V6) and the interaction between the treatment dose of fertilizer N:P:K 240:180:120 (P3) with the variety ADV Joss (V6).

Table 3. Average NDVI values at different doses of N:P:K fertilizer and varieties

Variety	Treatment			Average	NP (V) BNJ 0.05
	P1	P2	P3		
V1	0.71^{ab}_{p}	0.89^{a}_{p}	0.81^{a}_{p}	0.80	
V2	0.71^{ab}_{pq}	0.52^{b}_{q}	0.73^{a}_{p}	0.65	
V3	0.73^{ab}_{p}	0.76^{a}_{p}	0.81^{a}_{p}	0.77	
V4	$\mathbf{0.89^{a}_{p}}$	0.87^{a}_{p}	0.70^{a}_{p}	0.82	0.16
V5	0.67^{ab}_{p}	0.67^{ab}_{p}	0.73^{a}_{p}	0.69	
V6	0.86^{a}_{p}	0.71^{ab}_{p}	0.86^{a}_{p}	0.81	
V7	0.52^{b}_{q}	0.76^{ab}_{p}	0.81^{a}_{p}	0.70	
Average	0.73	0.74	0.78	0.75	
NP (P) BNJ 0.05		0.16			

Notes: Numbers followed by the same letter in column (a,b) and row (p,q) mean not different in BNJ test at $\alpha = 0.05$.

Table 3 shows that the interaction between the treatment dose of N:P:K 160:120:80 (P1) with the variety JH 36 gave the highest average value with a value of 0.89 and significantly different from the array Jakarin (V2) at the same dose of N:P:K fertilizer, the interaction between the treatment dose of N:P:K 200:150:100 (P2) with varieties Bisi 18 (V5), and Pioner (V7). And not significantly different from the interaction between the treatment dose of N:P:K 160:120:80 (P1) with the variety ADV Joss (V6), the interaction between the treatment dose of N:P:K 240:180:120 (P3) with the types Sinhas 1 (V1) Jakarin (V2), Nasa 29 (V3), JH 36 (V4), Bisi 18 (V5), ADV Joss

(V6), and Pioner (V7).

Table 4. Correlation Matrix between Observation Parameters

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	1																							
2	0.4**	1																						
3	0.28*	0.43**	1																					
4	-0.03TN	-0.12TN	0.2TN	1																				
5	-0.17TN	0.1TN	0.16TN	0.22TN	1																			
6	-0.17TN	-0.15TN	-0.11TN	0.35**	0.47**	1																		
7	0.04TN	-0.23TN	-0.26*	0.06TN	-0.66**	0.34**	1																	
8	0.31*	0.02TN	-0.01TN	-0.18TN	-0.34**	-0.26*	0.14TN	1																
9	0.32*	0.28*	0.56**	-0.01TN	0.17TN	-0.12TN	-0.28*	0.18TN	1															
10	0.06TN	0.34**	0.03TN	-0.38**	-0.16TN	-0.22TN	-0.01TN	0.14TN	0.19TN	1														
11	0.31*	0.34**	0.29*	-0.08TN	0.17TN	-0.23TN	-0.38**	0.14TN	0.56**	0.33**	1													
12	0.18TN	0.25TN	0.06TN	-0.25*	-0.14TN	-0.54**	-0.31*	0.06TN	0.25TN	0.49**	0.46**	1												
13	0.08TN	0.33*	0.22TN	-0.07TN	-0.11TN	-0.25*	-0.09TN	0.08TN	0.16TN	0.34**	0.13TN	0.45**	1											
14	0.27*	0.22TN	0.21TN	0.11TN	-0.09TN	-0.1TN	0.01TN	0.14TN	0.23TN	0.18TN	0.14TN	0.22TN	0.36**	1										
15	0.14TN	0.18TN	0.07TN	-0.13TN	-0.09TN	-0.38**	-0.23TN	0.11TN	0.34**	0.33**	0.54**	0.56**	0.39**	-0.01TN	1									
16	0.35**	0.48**	0.47**	-0.1TN	0.11TN	-0.16TN	-0.25*	0.2TN	0.82**	0.42**	0.61**	0.38**	0.28*	0.33**	0.43**	1								
17	-0.03TN	0.07TN	0.26*	0.22TN	0.2TN	0.01TN	-0.2TN	-0.26*	0.31*	0.09TN	0.27*	0.24TN	0.26*	0.08TN	0.38**	0.3*	1							
18	0.11TN	0.09TN	0.11TN	-0.07TN	-0.13TN	-0.21TN	-0.04TN	-0.02TN	0.22TN	0.38**	0.28*	0.38**	-0.02TN	-0.07TN	0.45**	0.29*	0.32*	1						
19	0.13TN	0.04TN	0.19TN	0.16TN	0.07TN	-0.03TN	-0.1TN	-0.27*	0.27*	0.18TN	0.29*	0.24TN	0.14TN	-0.06TN	0.43**	0.28*	0.82**	0.64**	1					
20	0.19TN	0.17TN	0.53**	0.29*	0.2TN	0.28*	0.03TN	0.01TN	0.29*	-0.24TN	0.07TN	-0.43**	0.07TN	0.16TN	-0.13TN	0.22TN	0.19TN	-0.13TN	0.04TN	1				
21	0.09TN	0.17TN	0.49**	0.22TN	0.26*	0.16TN	-0.13TN	0.05TN	0.35**	-0.14TN	0.08TN	-0.36**	0.16TN	0.16TN	-0.03TN	0.26*	0.11TN	-0.16TN	-0.05TN	0.77**	1			
22	0.25TN	0.21TN	0.64**	0.37**	0.09TN	0.13TN	0.02TN	0.2TN	0.39**	-0.22TN	0.08TN	-0.29*	0.07TN	0.24TN	-0.11TN	0.25TN	0.13TN	-0.06TN	0.03TN	0.67**	0.68**	1		
23	0.19TN	0.18TN	0.39**	0.1TN	0.16TN	0.19TN	-0.01TN	0.04TN	0.43**	0.09TN	0.26*	-0.13TN	-0.01TN	-0.05TN	0.06TN	0.38**	0.24TN	0.14TN	0.3*	0.34**	0.32*	0.39**	1	
24	0.37**	0.47**	0.47**	-0.06TN	0.11TN	-0.13TN	-0.22TN	0.2TN	0.83**	0.38**	0.59**	0.32*	0.28*	0.35**	0.43**	0.98**	0.3*	0.26*	0.26*	0.27*	0.28*	0.28*	0.37**	1

Note: the number followed by the sign means (**) = very real, (*) = real, tn = not real,

1. Plant Height
2. Number of leaves
3. Stem Diameter
4. Harvest Age
5. Flowering Age of Females
6. Male Flowering Age
7. Anthesis Silking Interval (ASI)
8. Cob Height
9. Weight of Peeled Cobs
10. cob diameter
11. cob length
12. Length of Seeded Cobs
13. Number of Seed Lines Per Cob
14. Seed Yield
15. 1000 Seed Weight
16. Lint Cover 24. Productivity
17. Chlorophyll a Index
18. chlorophyll index b
19. total chlorophyll index
20. Light Absorbance
21. Light Reflection
22. Light Transmission
23. Normalized difference vegetation index (NDVI)

Correlation expresses the magnitude of the relationship that occurs between the observed parameters. The results of the correlation coefficient analysis in Table 4 show the results of the correlation analysis of all observation characters where the productivity parameter is the main parameter, so the correlation of productivity parameters is prioritized. The study showed that the parameters of plant height (r =0.37), number of leaves (r =0.47), stem diameter (r =0.47), cob weight (r =0.8), cob diameter (r =0.38), cob length (r =0.59), cob length (r =0.320), number of seed rows (r =0.28), 1000 seed weight (r =0.43), seed yield (r =0. 35), kelobot opening (r = 0.98), chlorophyll A (r = 0.3), chlorophyll B (r = 0.26), total chlorophyll (r = 0.26), light absorption (r = 0.27), light reflection (r = 0.28), light transmission (r = 0.28), and NDVI (r = 0.37) provide a positive correlation that has a significant effect and a very significant effect on productivity. It was not correlated with male flowering age (r = -0.06), female flowering age (r = -0.13), and anthesis silking interval (r = -0.22).

2. Discussion

Fertilizer is among the most critical production factors besides land, labour and capital. Balanced fertilization plays a vital role in efforts to increase corn yields. Fertilization recommendations should be made more rational and balanced based on the ability of the soil to provide nutrients and the needs of plants for nutrients, thus increasing the effectiveness and efficiency of fertilizer use and production without damaging the environment due to excessive fertilization (Tuherkih and Sipahutar, 2008). Organic fertilizer can improve soil structure, increase soil absorption of water, improve living conditions, and act as a plant food source. Meanwhile, inorganic fertilizers can stimulate overall growth, especially branches, stems, and leaves, and play an essential role in forming green leaves (Lingga, 2008).

Productivity is a consistent parameter influenced by the interaction of treatments and varieties. The genetic traits of the type strongly influence corn productivity, and these traits can only develop in an optimized environment. The more cultivation technology used, the more varied the production will be. Fahrurrozi F., Muktamar Z., Setyowati N., Sudjatmiko S., dan Chozin M (2019) said that productivity is significantly influenced by environmental relationships, along with plant density. Therefore, various N:P:K fertilizers and varieties can be applied to increase corn production.

The treatment combination that produced the lowest productivity was the N:P:K fertilizer dosage of 160:120:80, with the Jakarin variety (P1V2) showing a value of 3.81 t.ha-1. Flooding at the research site affects the growth and yield of corn plants, especially in the critical phase of flooding. Waterlogging stress causes anaerobic respiration in the root zone, affecting corn plants' metabolism. Plant responses to water stress can be seen in leaves and roots so that morphological characteristics and internal anatomical structures adapt to adverse environments. The main symptoms of leaves against waterlogging stress are curling, yellowing, wilting, falling, and rotting, which causes decreased production.

The productivity of the N:P:K fertilizer dose of 240:180:120 (P3) showed the highest average of 6.66 t.ha-1 compared to other fertilizer doses. As described by Lingga & Marsono (2013), the provision of urea, TSP and KCl fertilizers as a source of N, P and K is an effort to increase crop production. Nitrogen (N) is one of the macronutrients for plant growth, which is generally needed for plants' vegetative growth, such as roots, stems and leaves. Phosphorus is one of the essential macro-nutrients for plant growth and yield. It plays a vital role in spurring the formation of flowers and spikelets in panicles, strengthening straw so it does not lodge and improving grain quality. The central part of potassium for plants is an activator of various enzymes that play a role in metabolic processes (Husnain A., Kasno, S., dan Rochayati, 2016). The environment also affects the increase of corn crop production. An environment with optimal water availability can help corn plants in the vegetative and generative phases. Sirappa and Nasruddin Razak (2010) reported that if maize plants experience drought stress in the flowering or seed-filling phase, the yield is only about 30-60% of the work under normal conditions, while if drought stress occurs in the flowering stage until harvest, the product is approximately 15-30% of the creation of plants that do not experience drought stress. Waterlogged maize plants in the vegetative phase cause plants to become stunted, leaves curl, rot, and are susceptible to disease attacks. Corn plants that grow with sufficient water will produce optimal productivity.

The highest average productivity was obtained from the ADV variety (V6) with a value of 9.28 t.ha-1. Increased productivity cannot be separated from selecting suitable types that have physical and biological advantages. Bahtiar, B., Azrai, M., Biba, M.A., and Syakir, M (2018) explained that the benefits of ADV varieties have the main characteristics of very high yield potential, reaching 13.5 tons of dry peeled/hectare, high yield, and drought tolerance, so it is perfect to be planted in the dry season and in areas with minimal rainfall potential, and patience to downy mildew which is the primary disease of corn plants. ADV varieties are reliable in areas with high disease stress.

The lowest average productivity value was obtained from the Sinhas 1 (v3) variety, which was 4.53 t.ha-1 lower than other varieties. Genetic differences between varieties, such as adaptability and disease resistance, play a role in determining crop productivity. Variety is also another factor that plays a vital role in determining crop productivity. Apart from that, the cropping conditions during the study were also waterlogged, which caused water stress. Waterlogging stress causes anaerobic respiration in the root region, affecting corn plants' metabolism. The plant's response to water stress can be seen in leaves and roots so that morphological characteristics and internal anatomical structures adapt to adverse environments.

The Normalized Difference Vegetation Index (NDVI) variance results showed that the ADV Joss variety showed the best vegetation index value with a value of 0.82. The validation test results show the potential of imagery with this model to estimate the greenness of vegetation, especially by using the value of the vegetation index, which has a strong relationship with field measurements. Wahono, D. Indradewa, B.H Sunarminto, E Haryono, and D. Prajitno (2019) supports this in that using Unmanned aerial vehicles (UAV) with ArcGIS software provides complete and accurate data information. Digital image data from the range of light obtained from uncrewed aircraft can be used to quickly assess and record leaf chlorophyll and N content in corn plant leaves. Using UAVs and multispectral cameras, data capture can produce high-resolution Normalized Difference Vegetation Index (NDVI) readings. NDVI is highly proposed because light absorption and reflectance in leaves have been measured with a technological approach from satellites. NDVI data provides a strong approximation in measuring leaf chlorophyll and nitrogen concentrations during the growing season.

The correlation coefficient shows the close relationship between the two variables. The correlation coefficient ranges from -1 to +1. If a correlation value of zero is obtained, it can be concluded that there is no correlation between the two traits. The relationship shown is very close if the coefficient value is brought closer to +1. If the correlation value is more comparable to +1, an increase in one trait will be followed by a rise in the other trait and closer to - 1 means that an increase in one feature will reduce the additional quality. The criteria for the degree of closeness based on the correlation coefficient are 0: no correlation between two variables, 0 - 0.25: very low correlation, 0.25 - 0.5: moderate correlation, 0.5 - 0.75 = high correlation, 0.75 - 0.99 = very high correlation, while 1 = perfect correlation.

Based on the results of the correlation analysis, the characters of plant height (r=0.37), cob diameter (r=0.47), number of rows of seeds per cob (r=0.28), 1000 seed weight (r=0.43), peeled cob weight (r=0.83) and NDVI value (r=-0.37) have a significant influence on productivity, so that these characters can be used as a standard or as a consideration in determining fertilizer packages, varieties, and interaction of fertilizer packages with types in this study. According to Priyanto, S.B., A. Muhammad, and T.M Andi (2018) hybrid corn research (2017), one of the characteristics that correlate very significantly with yield is the weight of the cob. This proves that the importance of the hulled cob influences gain, where the seed yield increases considerably according to the increase in the weight of the hulled cob. An increase in the weight of the cob with cob and cob without cob in corn plants will be in line with the quantity of yield obtained. This is in line with Pratikta, Sri and Ketut (2013) research, which states that cob weight affects corn production because the more significant the cob weight, the greater the corn production. Therefore, producing quality seeds and high seed productivity can be done by selecting plant height, cob height, cob diameter, number of rows of kernels per cob, weight of 1,000 seeds, length of seeded cob and weight of husked cob.

Production characters such as cob weight (r =0.83), cob diameter (r =0.38), cob length (r =0.59), seed cob length (r =0.32), number of seed rows (r =0.28), 1000 seed weight (r =0.43). It also showed a positive correlation with productivity parameters. The values obtained for cob diameter, cob length, cob length, number of seed rows, and 1000 seed weight directly affect maize productivity. The weight of 1000 seeds is a measure to determine the average weight and the accumulation of carbon dioxide net results throughout growth. This is in line with the opinion that carbon dioxide assimilation is the result of the absorption of solar energy due to solar radiation that is evenly distributed to the entire surface of the leaf that is absorbed and the efficiency of utilizing this energy for carbon dioxide fixation. The nutrients absorbed will be accumulated in the leaves into proteins that can form seeds; with the fulfilment of plant nutrients, the metabolism runs optimally, and the formation of seeds increases and has a maximum size and weight.

The correlation matrix table between observation parameters where the NDVI (Normalized Difference Vegetation Index) value character (r = 0.37) accurately correlates to productivity. The more active the photosynthesis process, the higher the NDVI value and vice versa; the lower the greenness of the plant will give a lower NDVI value. The relationship between NDVI and the growth phase of corn is related to the variation of NDVI values for each stage of corn growth. In their research, Farid and Wahono (2021) explained that vegetation age is classified as medium and the density of plant stands. The thickness of the plant canopy generally provides a high ratio value on the vegetation index value. In this study, it is analogous that the stand density also affects the canopy density, so the analysis results show a solid relationship. The denser the vegetation stands, the greater the canopy density and will affect the vegetation index value. The taller the corn plant and the older the plant, the denser the leaf canopy. The growth and change of a relatively thicker and denser vegetation canopy cover significantly affects the pixel value of aerial imagery so that the chlorophyll and nitrogen vegetation index values are higher.

C. Conclusion

From the results of the study it can be concluded that the morphophysiological parameters of several varieties of corn showed a significant effect, including the fertilizer dose that provides the highest productivity compared to the other three fertilizer packages, namely the fertilizer dose of N:P:K 240:180:120 (P3) showing the highest average of 6.66 t.ha-1, the variety that produces the highest productivity compared to five types is the ADV variety (V6) with an average value of 9.28 t.ha-1. The combination of N:P:K 160:120:80 fertilizer dose treatment with ADV Joss variety (P1V6) showed the highest productivity compared to other treatment combinations with a value of 9.38 t.ha-1.

D. References

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